Selecting Your GLOBE Study Sites

Initial Considerations

The selection of the local study and sample sites can be an opportunity to begin an inventory of the area around the school, and to discuss criteria for measurement sites. What is a good place to measure water temperature, and why? What do you have to consider when planning where to dig a soil profile? Where can you get representative samples of soil moisture, and what might influence the choice of sampling strategy? How can my Landsat imagery help me with these decisions? These are only a few of the multiple questions that can serve as catalysts for learning.

For each measurement site within your GLOBE Study Site there will be hard choices to make because no one will have a perfect set of locations. This is an opportunity to work on solving problems with your students in order to come up with the best arrangement for your class, your school, and your schedule. We suggest you try to come up with several candidates for site selection and have your students be active participants in the selection process.

GLOBE Study Site

Your GLOBE Study Site is the 15 km by 15 km area centered on your school. All of the smaller study sites are located within this large GLOBE Study Site. GLOBE working with the Country Coordinators will provide a Landsat Thematic Mapper (TM) scene of this area. From an instructional standpoint, the goal of these sites is to give your students a feel for the physical resolution of satellite images as well as providing a suitable and convenient area upon which to focus student measurement activities.

Within your 15 km x 15 km GLOBE Study Site, you will select several specific study sites, corresponding to the individual protocols: Atmosphere, Hydrology, Soil Moisture, and Land Cover/Biology as detailed below. Once established, these study sites are locations to which students will return again and again to take measurements. The Land Cover and Soil Characterization protocols involve measurements which are done only once at specific locations which are referred to as sample sites.

Using the GPS Receiver to Determine the Location of Your School and Sites

The GLOBE Program owns GPS receivers which are maintained by the University Navstar Consortium (UNAVCO). To borrow a GPS receiver, U.S. schools should direct their requests to UNAVCO. Country coordinators may request to borrow GPS receivers from UNAVCO for use by their GLOBE schools. For more details, refer to the GPS Investigation.

Atmosphere Study Site

In the Atmosphere Study Site, your students will measure temperature, precipitation, cloud type and cloud amount. Since these are daily measurements, your Atmosphere Study Site should be located on or near your school grounds, so that students will have easy daily access to the instruments. However, there are some special siting considerations as detailed below.

1. Measurements of cloud amount and cloud type require an unobstructed view of the sky. The middle of a sports field or parking lot is an excellent location.
2. For measurements of precipitation, the rain gauge (and snowboard) must be in an open area with a natural (e.g. grassy) surface. Do not place the rain gauge close to buildings, trees or high bushes, which can affect the amount of rain that collects in the rain gauge. An open field, a playground, or the side of a sports field would be good locations for the rain gauge. The snowboard should also be placed in an open area, away from buildings, with special care to select a place where snow shoveling will not pile snow onto or clear snow from the board.
3. For measurements of temperature, you need to put the thermometer in a small standardized, protective shelter. This shelter, painted white, with slats on the sides to let air circulate, is mounted on a post. The shelter has a door, enabling

students to look in to read the temperatures. As with the rain gauge, the instrument shelter should be in an open area with a natural (e.g. grassy) surface, away from buildings, trees or high bushes.

If possible, place the rain gauge within 100 meters of the Soil Moisture Study Site (see below), as the rain data will help students and scientists better understand the soil moisture data. Also, closeness will facilitate students taking weekly soil temperature measurements at the same time that they collect atmosphere data.

Some schools cannot meet all these criteria for locating their Atmosphere Study Site. GLOBE encourages such schools to describe carefully all the ways in which their site differs from the criteria given in this guide and to report this information on the Atmosphere Study Site Definition Data Entry Sheet. For more details, refer to the Atmosphere Investigation.

Hydrology Study Site

Water characteristics will be measured in your GLOBE Study Site, at a body of water, such as a lake, river or stream. There are two steps to selecting your Hydrology Study Site. First, you need to determine which bodies of water (streams, rivers, lakes, bays, the ocean, ponds, and reservoirs) are in your GLOBE Study Site. You can determine this from local maps or from the Landsat image of your GLOBE Study Site. Second, you need to select one that is most appropriate for the Hydrology Investigation.

Ideally, the Hydrology Study Site should be within the major watershed of the 15 km by 15 km GLOBE Study Site, and connected to water systems that flow into larger river or estuary systems. This means that if your site includes more than one watershed, you have to figure out which one is most important. Within this watershed, select a specific site where the hydrology measurements (water temperature, dissolved oxygen, nitrate, pH, alkalinity, turbidity, and either conductivity or salinity) will be taken.

If the selected study site is a moving body of water (i.e. stream or river), locate your sampling site at a riffle area as opposed to still water or rapids. This will provide a more representative measurement of the water in the stream or river.

If the selected study site is a still body of water (i.e. a lake or reservoir), find a sampling site near the outlet area or along the middle of the water body. Avoid inlet areas. A bridge or a pier are good choices. If your water body is brackish or salty, you will need to know the times of high and low tide at a location as close as possible to your study site.

Hydrology measurements should be taken weekly, and therefore it is important that your study site be easily accessible to students on a routine basis. A site which is ideal from a science perspective but where transportation problems prevent students from taking measurements regularly is not as good as an acceptable site whose location is conducive to routine observations.

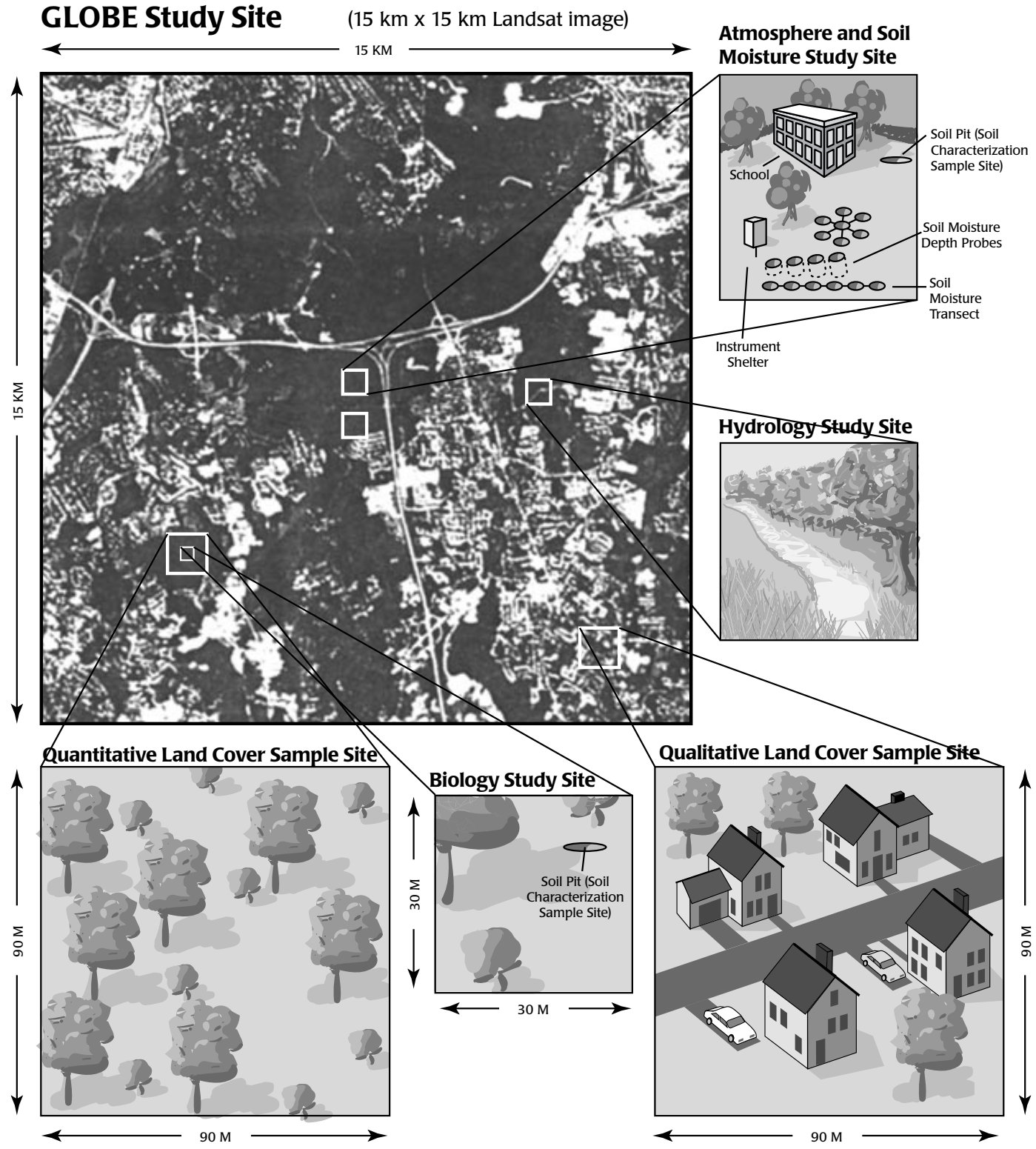
Soil Study and Sample Sites

For the Soil Investigation, there are two types of sites: Soil Characterization Sample Sites and a Soil Moisture Study Site.

At Soil Characterization Sample Sites, holes will be dug to expose the soil profile and permit the collection of soil samples and the examination of the various soil layers or horizons. One site should be located within the Biology Study Site in order to link the soil type with land cover characteristics. A second site should be located as close as possible to the Soil Moisture Study Site. In this way, the soil properties needed to interpret soil moisture measurements can be determined.

At Soil Moisture Study Sites, either of two soil moisture measurement techniques may be employed. The first uses a technique called *gravimetric sampling* and simply involves collecting soil samples and drying them to determine their moisture content. Samples are collected 12 times during a year, and the timing and pattern of collection are chosen by you and your students from a set of options described in the Soil Investigation. The second, which is optional and only recommended for advanced students in areas where the soil is not acidic, involves burying gypsum block moisture sensors at four specified depths in the soil and collecting readings from

Figure IMP-I-14: The Relations of GLOBE Study Sites



the sensors on a daily basis. Wires extend from the buried blocks to the surface, and to take a reading, you connect a meter to each pair of wires in turn.

The time it takes water to infiltrate the soil and the near-surface soil temperature are measured at the Soil Moisture Study Site. The timing and sampling pattern for these observations along with the details on all soil measurements are described in the Soil Investigation.

To enable correlation of the atmosphere data with the soil moisture and temperature data, a Soil Moisture Study Site must be located within 100 m of the rain gauge in the Atmosphere Study Site. This results in there being a single Atmosphere and Soil Moisture Study Site as shown in Figure IMP-I-14. Throughout the rest of the guide the two sites are referred to individually. If this collocation is not possible, a second rain gauge can be placed at the Soil Moisture Study Site and monitored during the period in which Soil Moisture measurements are being collected to provide the needed data on moisture input to the soil. These precipitation data can be reported to GLOBE by defining a second Atmosphere Study Site at which only the precipitation data are collected and reported. Soil temperature data can be collected at the Atmosphere Study Site throughout the year and at the Soil Moisture Study Site during the period in which soil moisture measurements are being collected to provide data for correlation with both soil moisture and atmospheric temperature.

Land Cover/Biology Study and Sample Sites

In the *Land Cover/Biology Investigation* students monitor the changes in vegetation at a Biology Study Site and characterize the land cover of the GLOBE Study Site by making observations at a number of Land Cover Sample Sites. The data from these sample sites are compared with the Landsat data and images of your 15 km by 15 km GLOBE Study Site to determine the accuracy of the satellite observations. This accuracy assessment is done by scientists and can be done by your students as well.

Land Cover Sample Sites, which are used to document land cover characteristics, are 90 m by 90 m in size. The site must be in an area with similar (homogeneous) cover. These characteristics are needed to enable verification of satellite data. There are two types of land cover sites. In areas of forest, woodland, and grassland, extensive measurements can be made of the vegetation; if these data are collected, these sites are Quantitative Land Cover Sample Sites. If these vegetation measurements are not made at the forest, woodland, or grassland sites, then they are Qualitative Land Cover Sample Sites. In other areas, the type of cover is determined only by observation because currently there are no extensive GLOBE vegetation measurement protocols for these cover types. These sites are also Qualitative Land Cover Sample Sites.

As you have time (perhaps over several years) your students should observe at least one Land Cover Sample Site for each major type of land cover found within your GLOBE Study Site. In GLOBE, land cover is classified using the Modified UNESCO Classification (MUC) found in the *Land Cover/Biology Investigation.*

Your Biology Study Site is a 30 m by 30 m area of natural vegetation. All new Biology Quantitative Study Sites must be located within one of the Land Cover Sample Sites. Biometry measurements are made once or twice each year — in the growing season and in the adverse season if there is one, and so access to the site is less of an issue than for sites of more frequent measurements. Students can practice biometry observations at a location adjacent to the school.

For further information on setting up these Land Cover and Biology Sites, see the *Land Cover/Biology Investigation*